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Seeded and Seedless Fruits Growth of "Sah Keng" Litchi[1]

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Abstract : The growth of seeded and seedless fruits of 'Sah Keng' variety litchi was studied. The seed grew rapidly in the early stage, the normal and aborted seeds could not be macroscopically distinguished untill about 30 days after full bloom. The volume and weight of normal seed increased continually and attended full size about 50 days after full bloom, however the aborted seed grew slowly and ceased about 40 days after full bloom. The growth of volume of seeded fruit, expressed as three components : length, diameter and thickness, was larger than seedless fruit. Increase in fruit length mainly occurred at early stage while that in diameter and thickness mainly occurred at later stage. Fruit weight increased rapidly in the later stage due to the growth of aril. The weight of seeded fruit was heavier than seedless fruit through growth period, but the aril weight between seeded and seedless fruit were not significantly different. It suggested that the seed size might be less important on the growth of aril in litchi. The total soluble solids in fruit increased continually and reached the maximum at maturity. The total soluble solids of seeded fruit was higher than seedless fruit, but not significantly.

Seedless fruits occur frequently in litchi. The size and weight of seedless fruits are smaller than seeded fruits, however, the aril ratio and eating quality, two important characters in litchi, are higher than seeded fruits[13]. The percentage of seedless fruits varies with different varieties, management, locations and years[5,13]. Variety is the most important factor. The 'Groff' variety was reported with 90% of seedless fruit in comparison with 0% in 'Hak Ip', 'Hon Pi' and 'Kaushiang Early' varieties[12,13]. The percentage of seedless fruits of famous seedles varieties are generally between 30—60% in Taiwan[5,13]. One seedling with seedless fruits as high as 99% was found in Nantou recently, however, the fruit size was smaller (about 17g) than 'Hak Ip' and 'Sah Keng' varieties. The percentage of seedless fruits is also affeceted by pollination behavior. In open pollination, none of seedless fruit was found in 'Hak Ip' variety, but in bagging and without-pollination treatment, 100% of seedless fruits could be obtained though the fruit-setting was seriously reduced[7].

The development of litchi fruit showed single sigmoid curve. The embryo develops

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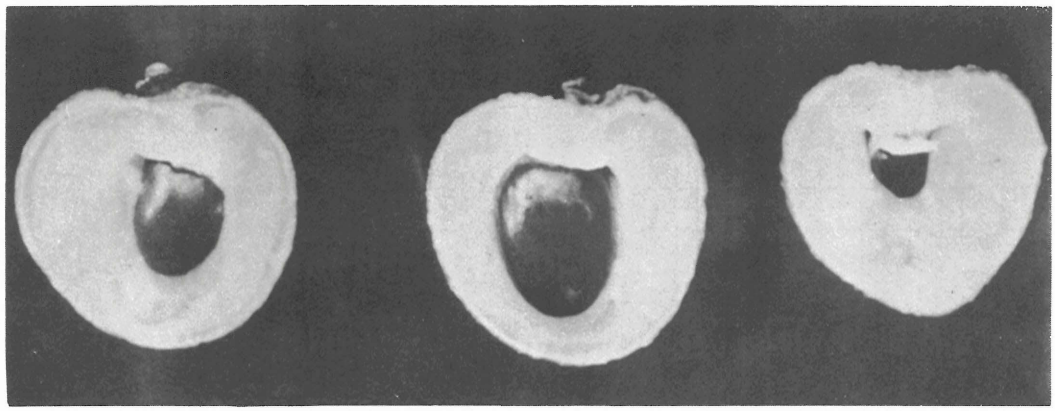

Fig. 1. The longitudinal section of matured seedless fruit (right) and seeded fruit (middle) of "Sah Keng" variety litchi at 80 days after bloom. In the left was a intermediate type which was considered as a seeded fruit.

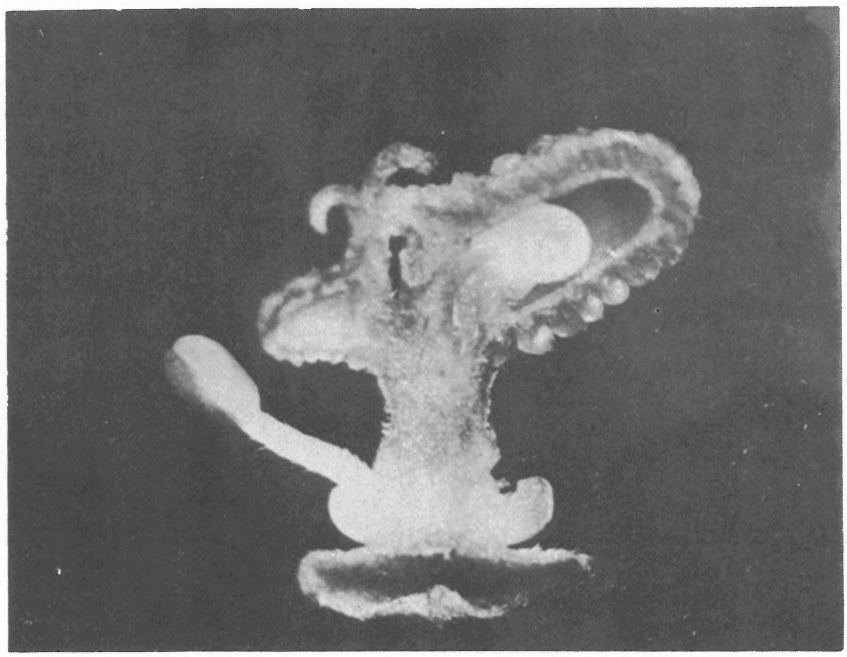

Fig. 2. A longitudinal section of "Sah Keng" variety litchi fruitlet with two loculi at 10 days after bloom. One loculus (at right side) began to grow as a fruit, the growth of other loculus (at left side) was ceased.

primarily in the early stage and the aril grows drastically in the later stage[8,9]. There is few report on the comparison of the differences in various growth components between seeded and seedless fruits. The purpose of this study is to investigate the development of seeded and seedless fruit in 'Sah Keng' variety.

MATERIAL AND METHODS

'Sah Keng' variety of litchi is suitable for this study for its similar number of seeded and seedless fruits[6,13]. In previous experiment, it appeared that the variation among tree was larger than within tree, samples were taken from ten trees to reduce the errors[13]. Fruits were collected from ten years old 'Sah Keng' variety grown in Chuchi, Chiayi. Ten fruits were sampled randomly from each tree at ten days interval from full bloom to maturity. The growth of fruit was determined on the basis of length, diameter, thickness and weight[3]. The length, diameter and thickness of fruit were measured with caliper, the total soluble solids was determined with hand refractameter. After fruit characters were measured, the seed was longistudinally cut to identify whether it was a normal or aborted (Fig. 1).

RESULTS AND DISCUSSION

After fertilization the fruit began to grow rapidly. The ovary has generally two loculi but usually only one loculus grew to form a fruit (Fig. 2). The growth of seed and fruit are expressed as cumulative weight and volume. The growth curve of litchi fruit was sigmoid. The volume of fruit showed a stable increase through the growth period. In contrast, the increase of fruit weight was faster during later stage. The growth pattern expressed either as volume or as weight, was significantly different in seeded and seedless fruits. The changes of percentage of fruit components in whole fruit on weight basis was shown (Fig. 3). The weight of seeded fruit was significantly higher than that of seedless one from 40 days bloom through maturity (Fig. 4). The peel

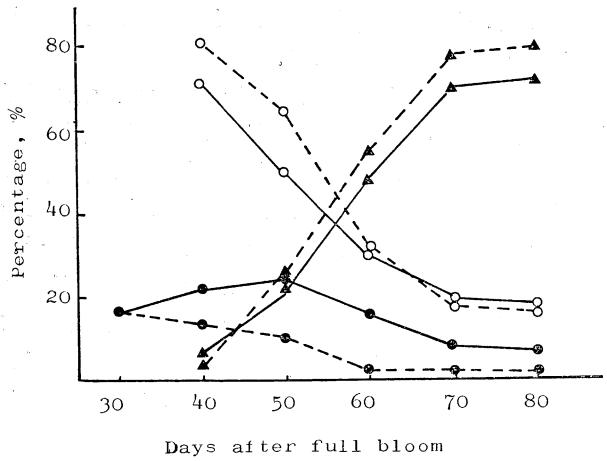

Fig. 3. Chages of percentage of seed (●), peel (○), and aril (▲) in whole fruit on weght basis. The differences between seeded (—) and seedless (···) litchi fruits were appeared.

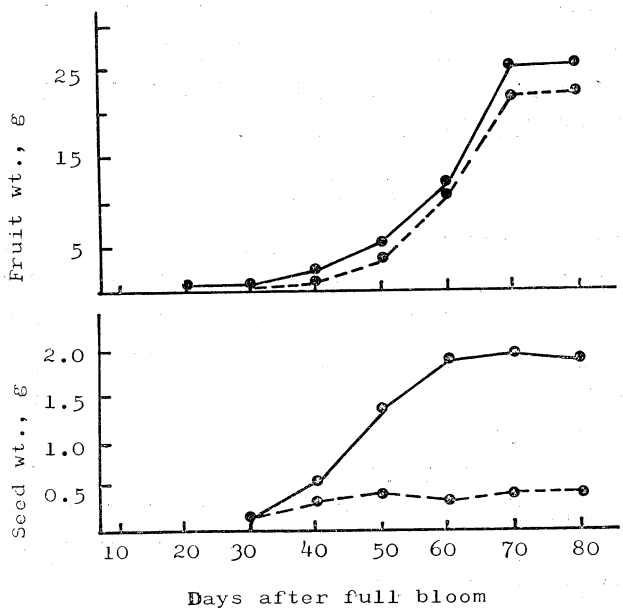

Fig. 4. Changes of fruit weight and seed weight of seeded (—) and seedless (···) fruits in 'Sah Keng' variety litchi.

and seed increased distinctly in the early stage, then slowed down from 60 days after full bloom. In early period, peel and seed were two main components of fruit (Fig. 3, 4, 5). In early stage, the aril could hardly be observed macroscopically but increased drastically during 50 to 70 days after full bloom. The percentage of aril in seedless fruit was significantly higher than seeded fruit (Fig. 3). In most fruit species, seed is a strong sink and via synthesis of growth substances, influence the growth of other fruit componets specially the edible pericarp. Aborted seed usually resulted in smaller and unmarketable seedless fruit[1], however, it appeared difference in litchi. The aril weight, despite of the difference of seed size, were not significantly differant in seeded and seedless litchi fruits (Fig. 5). It indicated that the influence of seed size on aril growth might not be so important as in other fruit[1].

The total soluble solids of fruit incresed gradually and attended the highest value at maturity (Fig. 5). Fang and Huang[4], and Lin and Chiang[10] also reported that the increase of total soluble solids was accompanied with the progress of maturity and reached the maximum in fully matured fruit. The fruits harvested at 7 'fen' maturity or 70% fruit peel turning red color had the longest storage life[10]. It seemed that the fruits of 'Sah Keng' variety harvested about 75 days after full bloom when the fruit volume, weight and total soluble solids was closely approched to that at maturity might be suitable for long distance transport. The total soluble solids in seeded fruit were higher than in seedless fruit, but it was not significant. This result confirmed previous report[13]. Huang considered that the flavor of seedless fruit was better than seeded fruit[5], but Mustard *et al* reported that quality of seedless fruit was inferior to seeded fruit[11]. Different varieties may explain the discrepant results.

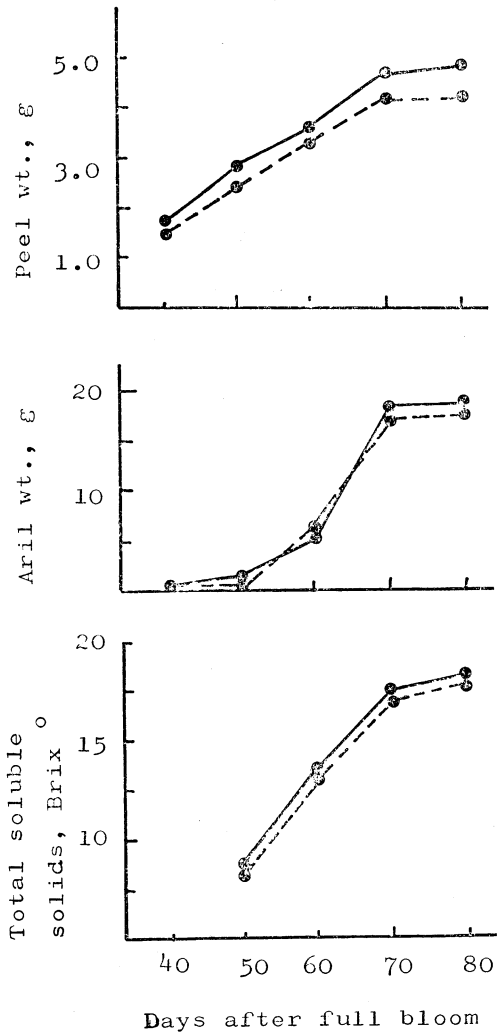

Fig. 5. Changes of peel weight, aril weight, and total soluble solids of seeded (—) and seedless (···) fruits in 'Sah Keng' variety litchi.

The volume of fruit was separated into three components : length, diameter and thickness. The increase of length was fast during 20 to 50 days after full bloom, while the increse of diameter and thickness was fast during 60 to 70 days after full bloom. The growth patterns of length, diameter and thickness were similar in seeded and seedless fruit (Fig. 6). The difference of fruit length of seeded and seedless fruit was not significant through the whole growth period, but the differences of diameter and thickness of fruit were significant from 40 to 80 days after full bloom. The diameter and thickness of seeded fruit were higher than seedless fruit. This confirmed previous report that there was a high correlation between seed size and fruit diameter, but the correlation between seed size and fruit length was low and not significant. As compare the time of seed growth and increase of diameter and thickness, it seemed that seed might play a role in growth of fruit diameter and thickness, which develop faster during later stage, thus, the diameter and thickness of seedless fruit were smaller might be due to seed aborted during early stage.

The increase of weight and volume of normal and aborted seeds showed significantly different from 30 days after full bloom through maturity. The increase of seed volume was fast at early stage, then ceased and the color of seed coat turned from green to brown about 50 days after full bloom (Fig. 6, 7). The growth pattern of volume components : length, diameter and thickness were similar in both normal and aborted seeds, but the volume of aborted seed was smaller and the growth ceased earlier than normal seed (Fig. 6). The increase of seed weight in normal and aborted seed showed significant difference. The normal seed grew continually and the inner parts was filled with embryo, however, the increase of weight of aborted seed ceased about 40 days after full bloom. the weight was never beyond 0.5 gram (Fig. 4) and a brown residual of ovule was observed in the cavity at 30 days after bloom (Fig. 8). Chang [2]

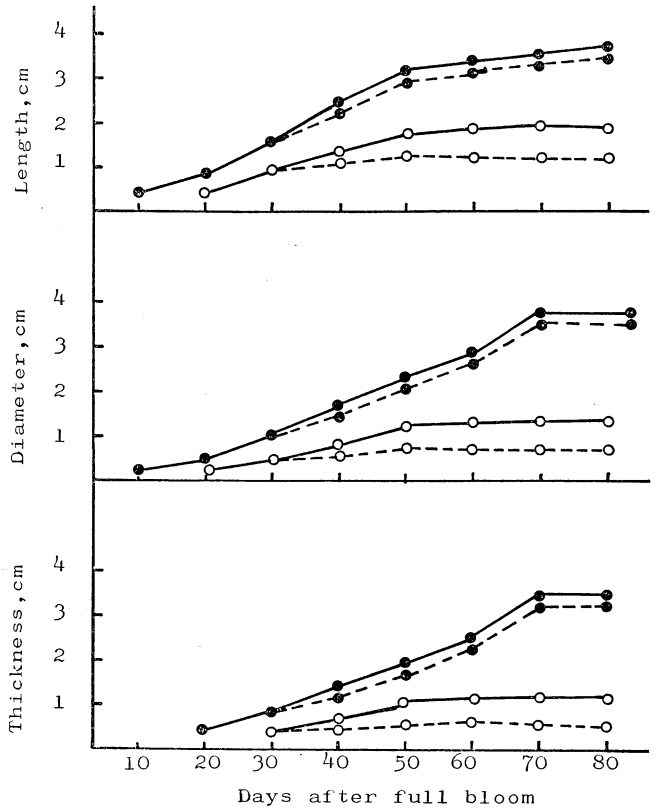

Fig. 6. Changes of volume components of fruit (●) and seed (○) between seeded (···) and seedless (···) fruits in 'Sah Keng' variety litchi.

and Mustard *et al*[11] reported that there was a large number of fruit drops as a result of embryo abortion from 2 weeks to 4 weeks after bloom. In this study the normal and aborted seed could not be distinguished untill 30 days after full bloom. It was evident that there was a critical period of fruit-setting from 10 to 30 days after full bloom. After this period the setted fruits grew rapidly despite that it was a normal or aborted seed inside.

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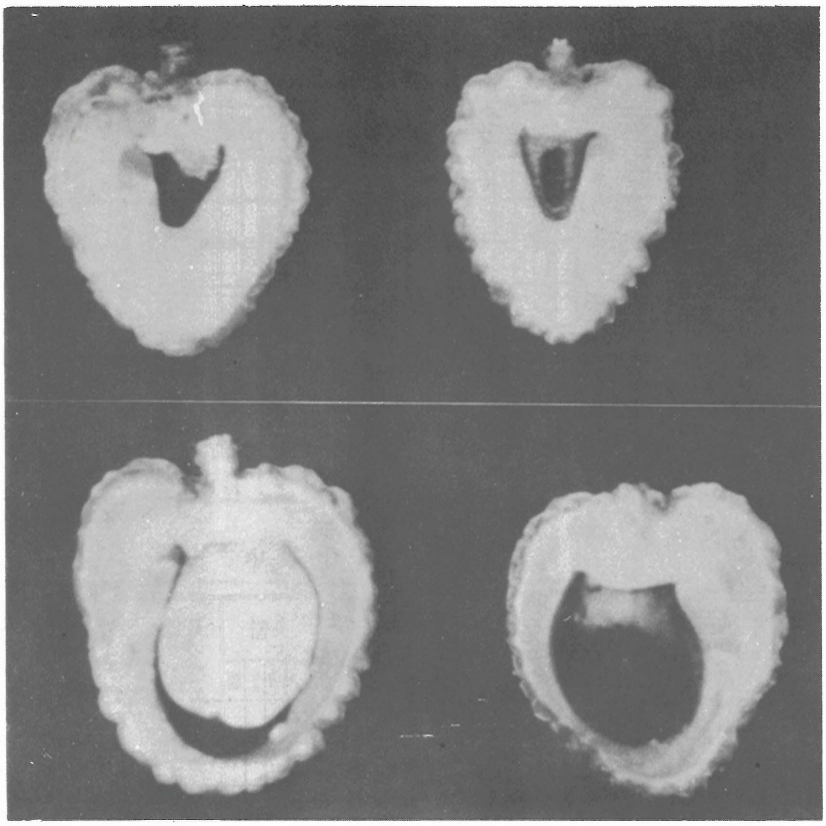

Fig. 7. The normal seeds (lower row) and aborted seeds (upper row) of "Sah Keng" variety litchi had approached full size 60 days after full bloom, but the growth of fruit volume and aril were not yet completed.

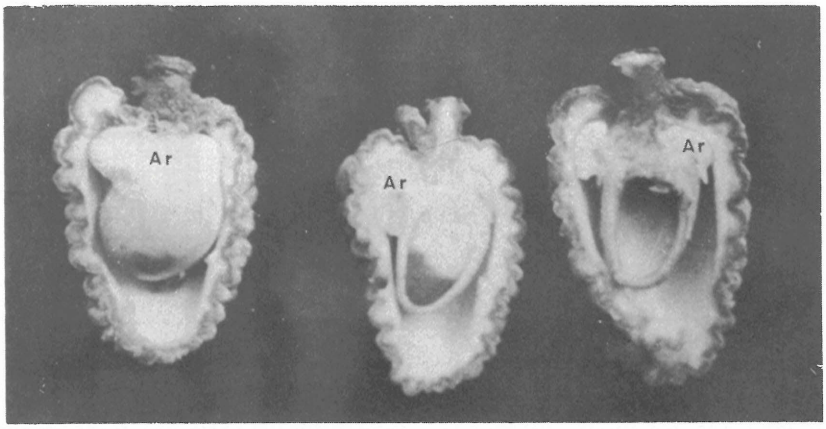

Fig. 8. The normal and aborted seeds could only be distinguished untill 30 days after full bloom, the cavity of normal seed was filled with cotyledons (middle) , but in aborted seed, a brown residual of ovule was observed in the cavity (right) , it was also shown that the aril (Ar) began to grow in both normal and aborted seeds (left) .

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沙坑種荔枝正常果及焦核果之生長[1]

顏 昌 瑞[2]

摘 要

研究荔枝沙坑種正常果及焦核果各構成部份之生長顯示種子於初期迅速增大，至花後30天正常及焦核種子發育即有顯著不同，此後正常種子之體積及重量均繼續增加，至花後50天即接近成熟大小，焦核則生長緩慢至40天即停止發育。果實體積以果長、果徑及果厚表示，正常果均大於焦核果，果長於初期增加較速，果徑及果厚在後期增加較速。果重在發育後期因果肉之生長而迅速增加，於發育過程，正常果之果重均顯著大於焦核果，但果肉重之差別則不顯著，顯示種子大小對果肉生長之影響不大。果肉可溶性固形物含量於發育期持續增加，至成熟期達到最高，正常果之可溶性固形物含量高於焦核果，但二者差異不顯著。

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